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J. E. STERLING
—Courtesy METAL INDUSTRY.

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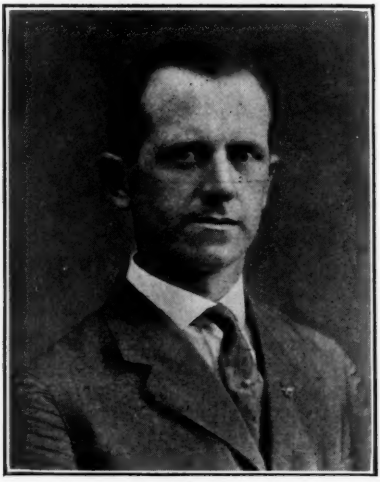

E. J. MUSICK

—Courtesy Metal Industry

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ONEIDA, NEW YORK

Editor's Office, 166 Willow Place, Sherrill, New York

VOL. X AUGUST, 1923 No. 8

EDITORIAL

MESSAGE FROM OUR PRESIDENT

To the Officers and Members of the Branches—

Gentlemen:—

I am taking the liberty of addressing each and everyone of our members through the columns of our Review.

First I wish to convey my sincere thanks to the delegates to the recent convention, for the honor they conferred upon me, by elevating me to the highest position within the gift of the great and growing Society, a Society quite unique in the field of trade organizations, as a matter of fact, it is not a trade organization, but a semi-scientific society, an entirely new departure in educational societies.

I also wish to assure the entire membership, that I thoroughly appreciate the honor conferred upon me and will strive to do my utmost to fulfill the duties imposed upon me, without fear or favor to anyone, but with the full consciousness of my duty to the A. E. S., as a whole. At the same time, being mindful of my limitations. I sincerely request the loyal assistance and cooperation of each and every member of our Society. I, like all of my predecessors, have a natural ambition to have the present administration equal the previous ones, and to surpass them if possible, but I realize that without your help, we can do nothing. Therefore, may I ask both the Officers and the Members to help me make a success of this administration.

First, by obeying the constitution and by-laws; second, by attending your Branch meetings as often as you possible

can, and doing your best to assist the Branch Officers to carry out the work of the Branch. You have placed them in their various positions, they are your employees, as it were, and it is your duty to assist them in every way possible. Present papers, or introduce subjects for discussion at the Branch Meetings, also do your full share by discussing the various topics under discussion. Do not be fearful of disclosing your knowledge, as you may be sure that in the end, you will receive a great deal more than you can give. You know, it is only by organization and cooperation that progress is made possible, and that is just what we are organized for, to assist and help one another to progress, and only through the exchange of our knowledge and experience can we expect to progress.

Third, by doing all you can to help our Editor make the Review a success, and help to us all. If it is to be of any value, it must have your support and assistance, if you are not willing to give something, the other fellow will not either and in the end, we both lose out. Even if you think you cannot write a paper in technical form, do not hesitate, send in your information, no matter what it relates to, as long as it concerns electroplating. Do not worry about the wording, etc:—What have we an editorial staff for?—they will take care of your contribution and get it in shape for publication.

May I also request the Branch Secretaries to assist the Supreme Secretary and Editor, by being prompt in sending in the reports of the meetings and the changes in the membership.

In conclusion, I wish to impress upon you, the fact that the success or failure of this administration depends upon each and every member, just as much as it does upon the efforts of the Supreme Officers, who, I can assure you, will do everything in their power for the advancement of the A. E. S.

Thanking you all in advance for your kind assistance.

I am yours
Sincerely,
JOHN E. STERLING
Supreme President

PRINCIPLES OF THROWING POWER

(Abstract of Address by W. Blum at A. E. S. Convention, Providence, July 3, 1923)

1.—INTRODUCTION

In both electroplating and electroforming[1], it is generally desirable to produce deposits with as nearly uniform thickness as possible over the entire cathode surface. In plating irregularly shaped articles it is usually necessary to have some minimum thickness of metal, for appearance or protection, upon all parts of the object. In producing this minimum thickness upon the least accessible part, it is desirable (from the standpoint of economy) to deposit as little excess metal as possible upon the rest of the object. To the extent that this is accomplished, good throwing power is secured.

Experiments were recently conducted at the Bureau of Standards to determine the fundamental principles which govern the metal distribution and throwing power. The details of these experiments were presented[2] to the 1923 spring meeting of the American Electrochemical Society. The principal conclusions are summarized in the following pages:

The experiments thus far conducted have been confined principally to copper sulphate and cyanide solutions. Studies are now in progress upon the throwing power of nickel plating solutions.

2.—DEFINITIONS

The term "throwing power" has been extensively used, but never clearly defined. Before giving a definition it is desirable to explain several terms which are related to it:

(a) Primary Current Distribution

Whenever an irregularly shaped article is made the cathode in a plating solution, certain points on it are nearer to the anode than others, and the resistance through the solution is naturally less from the anode to a near than to a far point on the cathode. Accordingly the current density (e. g. in amperes per sq. ft.) is greater upon the near than upon the far point. Thus, if the resistance to the near point is only one-fifth as great as to the far point, we would naturally expect to get five times as high a current density (and five times the thickness of metal) upon the former as upon the latter. This current ratio which is dependent simply

upon the shape and position of the cathode, and is practically independent of the composition of the solution or conditions of operation is known as the "primary current distribution ratio." In the illustration given this is equal to 5.

(b) **Secondary Current Distribution**

The actual or "secondary" current distribution in any plating operation is almost invariably more nearly uniform than the primary distribution, owing to the cathode polarization, to be explained shortly. Thus, in the above illustration the actual current density may be 4.5 (instead of 5) times as great upon the near as upon the far point.

(c) **Metal Distribution**

The relative amounts of metal deposited upon the two points will depend not only upon the actual current densities at these points, but also upon the cathode efficiencies. Thus in a given case hydrogen may be evolved at the higher current density and reduce the metal efficiency there to such an extent that the ratio of the weights (or thicknesses) of metal deposited upon the two points may become 4, instead of 4.5 or 5.

(d) **Throwing Power**

In order to compare the throwing power of different solutions, or under different conditions, it is desirable to define this property in numerical terms. It may be defined as "the deviation (in per cent.) of the metal distribution ratio from the primary current distribution ratio." In the illustration used above, if the primary ratio is 5 and the metal ratio is 4, the throwing power is $\frac{5-4}{5} = \frac{1}{5} = 20$ per cent. As thus defined, this is equivalent to stating that in a simple case, while depositing a desired thickness on the far part, 20 per cent. less metal will be deposited on the near part than if there were no throwing power.

3.—FACTORS IN THROWING POWER

The investigation showed that the throwing power in any given apparatus and under definite conditions, depends upon (a) the cathode polarization, (b) the conductivity of the solution, and (c) the cathode efficiencies. These effects will be considered separately.

(a) **Cathode Polarization.** Whenever metal is deposit-

ed upon a cathode, the film of solution at the cathode will become somewhat depleted, i. e., will contain a lower concentration of metal salt (and metal ions) than does the body of the solution. The higher the current density and rate of deposition the more dilute does the cathode film become. The cathode single potential (i. e., the difference in potential between the cathode and the adjacent film of solution) required to deposit metal on the cathode surface, is higher the more dilute the solution. Consequently it requires a higher potential to deposit metal at a high than at a low current density. This increase in potential above that required when a negligible current is passed is known as the "cathode polarization." As a result of such polarization the deposition of metal is retarded most upon that point having the highest current density, i. e., the near point, and thus the metal distribution is made more nearly uniform and the throwing power is increased. The extent of this polarization, i. e., the degree to which the cathode film is depleted and the cathode potential increases as the current density is raisd, is different in different solutions. If it changes only slightly, as, e. g., in a lead plating solution, the throwing power is poor. If it changes very greatly, as in cyanide solutions, the throwing power is very good. In solutions of copper, zinc or nickel sulphates, the potential changes to a less extent than in cyanide solutions, and hence these sulphate solutions have only a moderate throwing power.

If the principal cause of an increase in throwing power is the depletion of the film of solution at the cathode surface, all factors such as agitation which tend to bring fresh solution to the cathode will reduce the throwing power.

(b) **Conductivity.** The higher the conductivity of the solution the lower will be the potential required to cause a given current to pass through it. The total potential drop between the anode and the cathode consists of three parts, (1) that corresponding to the polarization at the anode (where the concentration of the metal salt tends to increase and to require a higher potential to cause metal to go into solution), (2) that required to overcome the resistance through the solution and (3) that due to cathode polarization. If for simplicity we consider (1) is constant and negligible, then the sum of (2) and (3) must be equal to

the voltage applied. If the potential drop through the solution is made small (e. g., due to an increase in the conductivity), the effect of any polarization that occurs is relatively greater than in a solution with low conductivity; and hence the throwing power is improved. In general therefore throwing power of a given type of solution is aided by increasing the conductivity of the solution. Good conductivity is not of itself, however, an evidence of good throwing power.

(c) **Cathode Efficiency.** The cathode efficiency is the ratio of the weight of metal actually deposited by a given current to the maximum that could be deposited by that current, in accordance with Faraday's Law. In acid copper solutions the cathode efficiency at most current densities employed is close to 100 per cent., but in cyanide copper solutions it is only about 85 per cent. at low current densities and 60 per cent. or less at high current densities. If the cathode efficiency decreases as the current density increases, the weight and thickness of metal upon the part with high current density, i. e., the near point, must be relatively smaller than if the cathode efficiencies were equal on both parts. Such an increase in throwing power depends not upon increasing the weight of metal on the far part, but of decreasing that upon the near.

4.—EFFECT OF CONDITIONS ON THROWING POWER

The above principles may be illustrated by the results obtained with acid copper solutions in a simple apparatus. This consists of a rectangular hard rubber box in which two plates, each having an exposed area 10x10cm (4"x4") (equal to the cross-section of the box) are placed at definite distances from a gauze anode. The two plates "n" (near) and "f" (far) are connected with a thick metal rod to keep them at the same potential with respect to the anode, and therefore represent the two parts of any object such as that considered in the above discussion. The following conditions were employed as a "Standard" for purposes of comparison:

Composition of solution:	N	g/L	oz/gal
$CuSO_4 5H_2O$	1.5	187	25
H_2SO_4	1.5	73	10

Temperature—21°C (70°F)

Total current 2 amperes on 2 square decimeters (equivalent to an average current density of 1 amp./dm^2 or 9.3 amp./sq. ft.).

Primary current ratio = 5:1.

Under these conditions the throwing power was 9.4 per cent. Variation of the above conditions yielded the following results:

(a) **Current Density.** An increase in the total current to 4 amp. (i. e., in the average current density to 2 amp./dm^2 or 18.6 amp./sq. ft.) decreased the throwing power to 7.4 per cent. An increase in current density **usually** decreases the throwing power.

(b) **Temperature.** An elevation in temperature to 45°C (113°F) decreased the throwing power to 2.2 per cent. Warming a solution increases the conductivity but decreases the polarization. Usually the latter effect predominates.

(c) **Agitation.** Stirring the solution with air, as is done in electrotyping, decreased the throwing power to 3.4 per cent. In certain cases, however, a slight degree of agitation may prevent "pocketing" of the solutions in the recesses and thus improve throwing power.

(d) **Metal Salt Concentration.** An increase in the copper sulphate content to 2 N (249 g/L or 34 oz/gal), decreased the throwing power to 7.2 per cent., a natural result of increasing the supply of copper salt and copper ions.

(e) **Acid Concentration.** Increasing the sulphuric acid content to 2N (98g/L or 13 oz/gal), increased the throwing power to 10.8 per cent. The effect of the acidity is due principally to the increase in conductivity.

(f) **Addition Agents.** Neither aluminum sulphate nor dextrose produced any appreciable effect on throwing power. Colloidal substances, such as dextrin (which is present in commercial glucose) and gelatin increased the throwing power to 12 and 18 per cent., respectively. These results are probably due to the increased viscosity of the cathode film and consequent increase in polarization.

In the above investigation a few experiments with a cyanide copper solution showed that its throwing power is high, i. e., about 40 per cent., which corresponds with the general observations of platers. Part of this increase in throwing power is due to the relatively low cathode effici-

ency in copper cyanide solutions. The effects of changes in operating conditions in cyanide solutions were relatively less marked than those observed in the copper sulphate solutions.

It is not practicable to predict from these measurements the actual metal distribution ratio on any irregularly shaped article. The chief value of these principles is to indicate the probable direction of the effects of any changes in conditions, and thus to serve as a guide in the selection of conditions.

5.—CONCLUSION

A consideration of the above results indicates that the best throwing power, i. e., the most nearly uniform metal distribution, is secured under conditions which may not in all cases be desirable in other respects. The actual choice of conditions is therefore usually the result of a compromise. Thus the time involved may be a more serious consideration than the cost of the metal, in which case it may be more economical to plate the articles at a higher current density for a short time, even though the metal distribution is less uniform and more metal is therefore required than if a lower current density were applied for a longer period.

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[1]"Electroforming" is a new term recently suggested by W. Blum as an English substitute for the German term "galvanoplasty." It may be defined as "the production or reproduction of articles by electrodeposition." It includes electrotyping and the manufacture of matrices, tubes, etc., by electrodeposition.

[2]H. E. Haring and W. Blum—Trans. Amer. Electrochem. Soc. 43. 1923.

ELECTRODEPOSITION OF RARER METALS

Paper Read at Annual Convention of the American Electro-Platers' Society—Possibilities With Chromium, Tungsten, Tantalum, Etc.—How Iridium Helps Platinum

By Professor Colin G. Fink, Ph.D.

Within the last ten years considerable interest has been manifested by metallurgists and engineers in the electrodeposition of metals and metal alloys, not commonly included in the electro-plater's schedule. The experimental research along this line was prompted by various motives.

On the part of one group of investigators it was largely a desire to study the properties of thin sheets of metals; sheets that could be more easily produced electrolytically than by processes of melting and rolling. On the part of other investigators the desire has been primarily to find new coatings for the baser metals and alloys that would exhibit certain distinctive properties, such as hardness and resistance to wear ,or chemical inertness to corrosive media, or purely artistic effects as to color or finish of plate produced.

An Interesting Group of Metals

One of the most interesting group of metals that has been investigated is the so-called group of Mendelejeff's periodic table. This group comprises the metals chromium, molybdenum, tungsten and uranium. The properties of the individual metals of this group are very striking. For example, tungsten has the highest melting point 3260 degrees C. (or about 5800 degrees F.), of any metal; it has the highest tensile strength and the lowest coefficient of expansion (less than half that of platinum) ; it can be made extremely hard, so much so that it will wear down a diamond faster than steel; it is practically insoluble in all common acids—with the exception of hydrofluoric acid; it will take on a high lustrous polish as bright as nickel, and it can be "blued" very much like steel.

Chromium, also a metal of this group, has received an unusual amount of attention by metallurgists within recent years, owing to the valuable propetries imparted to iron and nickel by alloying these metals with various percentages of chromium. The increasing popularity of stainless or rustless steel, containing from 12 to 20 per cent. chromium, is well known to all of you. Stainless steel jackknives can be purchased today at the remarkably low price of ten cents. Another valuable property imparted by chromium when alloyed with iron or steel is its marked resistance to oxidation or corrosion at elevated temperatures. The resistance element of your electric toaster is made of a chromium-nickel alloy; the electric ovens used in the Ford and other automobile factories—ovens 12 feet high and about a block long—are equipped with electrical heating units composed of a chromium alloy.

Chromium Plate Will Last Indefinitely

Now it is an interesting fact that although chromium metal is not readily produced by ordinary furnace processes —so universally applicable to the production of iron, copper, lead, tin and other metals—it can be produced comparatively easily by electrolytic or electro-plating methods.

It is an interesting fact that although chromium is readily produced electrolytically, it is very difficult to produce it by any of the older metallurgical processes such as have been applied to iron and steel and nickel and copper and tin and lead. That is, you can produce chromium metal by the electro-plater's art, so to speak, comparatively easily, whereas it is very difficult to produce chromium metal in furnaces such as are used for making iron or copper or nickel.

A bath of chromic acid and a little chromium sulphate is an excellent plating bath, which will operate very satisfactorily at ordinary room temperatures, requires no mechanical stirring and will last almost indefinitely. Chromium metal andoes made by the alumino-thermic method show no signs of polarization even after prolonged use. No additional agents are required. The chromium plate produced has a bright silver-like lustre, adheres firmly to iron, steel, copper, brass and other metals and alloys. Chromium plate can be made very flexible and comparatively soft, or it can be made very hard and take on a high polish. Chromium-plated steel is highly resistant to atmospheric corrosion even when the air is saturated with such strongly corrosive agents as nitric acid fumes, hydrogensulphide, or ammonia vapors. Chromium-plated steel is an ideal structural material for bridges, transmission towers, tie rails, steel fences, etc. If the steel employed in the construction of Brooklyn Bridge had all been chromium plated, New York city would have saved millions of dollars expended in paint and labor in combating the ravages of rust.

There are five painters employed on Brooklyn Bridge, who have been on there for years and will be there for life. As soon as they finish at one end they go back and start the whole job over again. By the time they finish at one end it is time to start at the other again.

An important and distinctive property of chromium-

plated steel is its inertness to molten tin, molten zinc and molten brass, whereas steel not so plated is rapidly destroyed by these molten metals.

Chromium-plated steel is the only steel we have found so far which will resist the most corrosive liquid I know of, namely, liquid tin. Liquid tin is so corrosive that it will cut through magnesite brick. That is the brick which is used in furnaces and it is the best brick you can find. Molten tin will cut through that just like a hot iron will cut through a piece of ice. It doesn't seem to worry about the thickness of the brick at all.

Some of you might say, why use magnesite when there are other bricks? Why not use silicon brick? Silicon brick is even worse. Steel parts such as shells, linings, pipes, ducts, etc., entering into the construction of furnaces for tin or zinc roasting, or smelting, hot galvanizing, tinning or brass manufacture, when made of chromium plated iron or steel will last indefintely; whereas ordinary structures of today either metallic or refractory are rapidly destroyed by the strongly corrosive action of liquid tin or zinc or brass.

If you went into a zinc plant using the old retort process, you would find most of the plant is devoted to making linings and retorts. If they could only find a decent lining for their furnaces, but before they do that the electrodeposition of zinc is going to cut out the furnace entirely.

Just to digress a moment, it is interesting, in the history of the electro-deposition art, that it has been possible in such metals as zinc and copper and iron, to skip the furnace entirely. That is, starting out with the ore, you take an ore like iron sulphid, and treat it with a chloride solution of iron, ferric chloride, and you produce ferrous chloride; electrolyze that and produce your iron directly.

France has been operating a commercial plant for the last eleven years, producing iron pipes, iron deposited on a mandrel from a ferrous chloride solution. During that deposition process the ferrous chloride reverts to ferric chloride, the ferric chloride solution is drawn out of the tanks, goes over fresh ore, and the ore is leached with that ferric chloride solution, and then goes back into the plating tanks again, and in that way skips the furnace entirely.

Or, you take the zinc anaconda process. Start out with the zinc ore, leach that with spent electrolyte from your plating tank, enrich the solution with zinc, pass it back into the deposition tanks, using an insoluble anode; the zinc is plated out, the solution is weakened in zinc and is strengthened in acid, goes back onto the ore and then back into the tanks, and in that way skips the furnace process entirely.

The same is done in the largest copper plant in the world. Start out with your plating solution, which is very weak in copper, pass it over the copper ore, enrich the solution in copper, pass it back into the plating tanks, throw out the copper, enrich it in acid, and lower it in copper strength, pass it back onto the ore,, and there is no furnace in the process. The only furnace that is needed is in the very end when the cathodes are pulled and you want to change the shape of the deposit into some easily rolled shape. Then the cathode sheets are taken and melted down, and cast into what are called ingot bars or wire bars suitable for the wire drawing establishments or sheet rolling or brass making plants.

In carrying out the chromium plating, room temperature has been found to give best results. As regards tank construction, a wood tank, lead lined, has been found to be serviceable, as lead is very insoluble in chromic acid. Concrete tanks lined with sulphur-quartz have been suggested, but have not yet been tried out thoroughly. For small scale work, earthenware tanks, such as are used in the electrolytic separation of gold from silver, will be found very serviceable.

Plating With Tungsten

For the electrodeposition of tungsten, various baths have been proposed. F. G. Keyes (U. S. pat. 1293117, Feb. 4, 1919), prefers a bath of fused boric acid, whereas, C. G. van Brunt has obtained satisfactory results with a bath composed of tungstic acid dissolved in benzidine hydro-chloride. Tungsten oxide is much more readily reduced to metal than chromium oxide. Tungsten is very insoluble in hydrochloric acid and sulphuric acid, whereas chromium is rapidly dissolved in hydro-chloric and slowly in sulphuric.

Very little work has been done on the other two metals, uranium and molybdenum, belonging to this sixth group of

the periodic table. Molybdenum metal offers little advantage over chromium or tungsten. Molybdeunm and uranium are readily soluble in nitric acid, whereas tungsten and chromium are not. Attempts at plating out molybdenum and uranium from their nitrate solutions have so far been unsuccessful.

The fifth group of elements comprises the metals vanadium, columbium and tantalum. On account of the valuable properties imparted to steel through the addition of small percentages of vanadium, this metal has been carefully studied during the last ten years and its properties are fairly well known. Vanadium metal is silver-white and comparatively hard (85 on Mohn's scale). Vanadium metal retains its surface and lustre even in moist air and resists the action of such strong corroding agents as hydrochloric acid and bromic vapor. Vanadium metal can be plated from a solution of sodium vanadate dissolved in hydrochloric acid. The bath is kept at about 80 degree C. and the current density at about 2 amperes per square decimeter, or 18.6 amperes per square foot.* (*Cowper-Cowles, Eng. Min. J. 67, 744.)

How Tantalum Plating Is Done

During the war we carried out a series of experiments on tantalum plating and obtained promising results when using the tantalum oxalate bath. Tantalum metal anodes can be procured from the Fansteel Company of Chicago. Tantalum is darker than vanadium or chromium. It usually takes on a bluish tinge, which, however, is very pleasing. The metal can be made very hard and very tough. It resists all common acids, hydro-chloric, nitric and sulphuric included. Boiling in aqua regia does not dissolve it. The only acid which does attack the metal is hydroflouric. Further research on tantalum plating appears well worth while, in view of highly resistant qualities of the plate. Tantalum-plated steel is unagected by submersion into solutions of hydro-chloric acid or chlorides, whereas, chromium-plated steel slowly disintegrates.

Columbium is a common associate of tantalum in nature, the various minerals always containing certain quantities of both metals. The properties of columbium are very similar to those of tantalum. It is steel gray in color and insoluble

in all acids except hydroflouric. Now, whereas, it is important to separate tantalum from columbium for many of the applications of these metals in the case of electro-plating we can deposit an alloy of these two metals and obtain a protective coating which is as serviceable as the coating of either metal alone.

In the case of electro-plating, we do not need to go through the costly separation. We can start out with the mineral and reduce the two metals together and produce our columbium tantalum anode, and use it in place of either pure tantalum or pure columbium. The difference in price is one hundred to one, and the difference in effect is zero. So why use pure tantalum or pure columbium?

To the fourth group of the periodic table belong the metals titanium and zirconium. Both metals are found in comparatively large quantities in both hemispheres. Titanium, like vanadium, chrominum and tungsten, has been investigated largely from the steelman's point of view, but very little has been done to electro-plate either titanium or zirconium. Dr. M. A. Hunter of Troy has investigated the properties of titanium metal very carefully. The metal takes on high polish and can be made very hard. As regards its corroson resistant properties, it is much more readily attacked than tungsten, tantalum or chromium.

Titanium is one of the most abundant of metals, and it is a pity that not more work has been done on titanium along the electro-deposition line. A good deal of work has been done on the effect of titanium added to iron, that is,titanium steels. The same applies to zirconium. Most of the research that has been done on zirconium is directly connected with zirconium steel, but practically nothing has been done on the plating of zirconium or the properties of zirconium plate.

With the past few years research has also been carried out on the deposition or rare metal alloys. Although the electrodeposition of brass and bronze is carried out on a large commercial scale, no other alloys have as yet attained this stage. Some years ago considerable interest was shown in the electrodeposition of cobalt-nickel alloys, the plate obtained being found to be whiter than that of either metal plated out separately. Since the war, however, the price of

cobalt has mounted to such high levels that interest in the cobalt-nickel alloy has waned.

How Iridium Helps Platinum Plating

The jewelers are very much interested in platinum plating, but platinum plate is often very soft and becomes dull in appearance after a few months' time. Experiments on the hardening of the platinum plate by the introduction of a little iridium into the bath have been started, but no data has as yet been published. The alloys of platinum and iridium—like those of gold and iridium so familiar to all fountain pen manufacturers—are very hard and resist wear admirably well. Platinum-iridium alloys retain their surface lustre very much longer than pure platinum does.

Lead plating has found a number of very specific applications, according to George B. Hagaboom.

That is, the addition of a little iridium to the platinum will give you a platinum plate which will take a very high polish and hold its polish a good deal longer than the ordinary platinum plate.

Lead plating has found a number of very specific applications, during the war especially. You will remember that Mr. Geo. B. Hogaboom devoted considerable attention to lead plating of the insides of gas shells. It is interesting to note that an alloy of lead and thallium, about three parts of thallium to seven of lead, when exposed to sulphuric acid baths containing nitric and hydrochloric acids will resist disintegration very well indeed, whereas, lead alone goes to pieces very fast. Thallium metal can be bought on the market for $2 to $4 per pound; the lower grades contain a little lead and cadmium and are sufficiently pure for anode material in plating baths. Like lead, thallium forms a flousilicate, T1 SiF. Curiously enough, thallium is fairly soluble in dilute sulphuric acid, whereas, lead is not; on the other hand, lead is much more soluble in hydrochloric acid than thallium.

If you were to investigate the properties of thallium alone, you would not be enocuraged to try out the alloy because thallium alone is comparatively soluble in sulphuric acid; but when alloyed with lead it is very insoluible.

Just as the plating conditions for uniform brass and bronze deposits have been worked out, similarly the best

concentrations, acidity, current density, etc., will be worked out for a number of other alloys.

A roof made of tinned iron must be painted to protect it from the corrosive influences of a city atmosphere. If in place of pure tin an alloy of tin and nickel is used, about equal parts of each, the corrosive action is very much retarded.

Similarly, if, in electrogalvanizing iron or steel, we cause a simultaneous deposition of iron, nickel or cobalt, we obtain plates that are very much harder than the ordinary zinc plate and consequently will resist mechanical abrasion better.

The Use of Cadmium Cyanide

According to the finding of the oLndon Metallurgical Company, the addition of zinc cyanide or cadmium cyanide to the silver plating bath produces a silver plate of great hardness and resistance to abrasion.

That has been in use for some years and is fairly old now, but I fail to find that many people are using it in this country. The plate may contain as much as 25 per cent. cadmium. Cadmium plating as such has recently come into favor again, since cadmium is easily plated and presents a surface that takes a high polish and is tougher than zinc. It will be interesting to investigate the properties of zinc-cadmium alloy plate, in particular that of which contains about one molecule of zinc to three of cadmium.

There are a large number of alloys which ought to be investigated in order to determine whether or not they can be electrodeposited on iron, brass or copper. There are the alloys of nickel and chromium, cobalt and chromium, nickel and molybdenum, cobalt and cadmium, tin and cobalt, nickel and zinc, and many others.

I believe I have given you, in these few words, some idea of what there is yet to be done, and that there is ample opportunity for everybody to carry out research, and that we are nowhere near the end of the electro-plating art. It seems as though we have done everything we can do in one particular line—say, in silver; yet, there are many new fields still to be conquered.

Gentlemen, I thank you. (Applause.)

ON THE JOB

The national convention of the American Electro-Platers' Society, held in Providence last week, was indeed a novelty in such gatherings. All of us are cognizant of the usual trend of national conventions held in the good old summer time. The delegates and their wives arrive, register, and immediately begin to be pledged to vote for some other city as the place of meeting, and the chief excitement seems to cluster around this city fight. Eight out of ten of the delegates spend the greater part of their time elsewhere than in the convention hall, and when they return home truly report that they have had a ripping time.

The other two out of ten stick to the hall and loyally help to carry out the program successfully. When the time comes for the resolutions, the chairman of the resolutions committee presents a report covering everything under the sun, from one-cent postage to the League of Nations, and it goes through with a shout, and without much consideration. The delegates are out for some pleasure as well as business, and don't want to be bothered with too many details which might cause brain fag.

Now the platers were different. With about 400 delegates, the meetings were attended regularly by 350 people, and they ate up the scientific papers, read one after the other, as if they liked them. None of the allurements of such a city as Providence could keep any considerable number of them away from the convention hall. Even the great and glorious Fourth did not tempt them away from their duty. They read abstruse papers and listened to profound scientific thoughts right through the day. The fire works in the evening was to cause a slight vacation on the program, but "the rocket's red glare and bombs bursting in the air" could not distract their attention from cyanide and cognate subjects.

When it came to the resolutions the platers certainly showed class. Did any committee shove down their necks a cut and dried list of "therefore be it resolved?" Most certainly not. Each proposal was taken up and discussed separately, and each proposal was most emphatically jumped upon and debated.

We do not mean to suggest that jewelers' conventions

should go and do likewise with their resolutions, but jewelers could take a leaf out of the platers' book relative to giving such proposals careful consideration, and having no hesitancy in voting them down, if they did not approve of them, no matter whose feelings were hurt or whose ox was gored.—From Manufacturing Jeweler, July 12, 1923.

BRANCH NEWS

Detroit Branch

Regular meeting A. E. S. held Friday, August 3, with good attendance, Vice-President T. C. Eichstaedt presiding in the absence of Ben Miller, who arrived late. Minutes of previous meeting read and approved. Communications from Messrs. Powers, U. Re, F. J. Hanlon, Walter Fraine, W. F. Smith, E. S. Watson, W. Wright, H. E. Carr Metal Industry, and Merriman read and action taken where necessary.

No applications for membership were received, neither were any applicants elected.

H. S. Brockway, who is ill, will be visited by a committee of Lovering, Miller and Woodmansee, and flowers sent also. We sure miss H. S. when he is absent, as well as Charles Cequin, who is not in the best of health at present time.

Considerable of evening was spent discussing ball burnishing, and disclosed wide difference in methods of operation, as to speed of rotation particularly, varying from 12 to 60 revolutions per minute, with reports showing good results in each case, demonstrating that each line is a separate problem, as it should be, with research work necessary in most cases, to obtain satisfactory results.

Burnishing fluids varied from soap water and cyanide to whale oil soap, Murphy's oil soap and soda ash with a little caustic; also tri sodium phosphate and cyanide, "You pay your money and take your choice"; also sour wine or beer. Brown spots on zinc plated work from cyanide solution also caused much controversy.

Question as to what caused gauze brushes on dynamo to be consumed rapidly, and as to whether it would be caused by use of double throw switch, was answered by stating that it would not be caused by that, but might be caused by ground or short circuit in this tank, which would overload the dynamo, cause sparking and, of course, result in brushes consuming rapidly. Lack of specific data prevented an accurate answer.

Meeting was very enjoyable, and broke up at a late hour. A. E. Shepherd, King of Flint, was with us and as usual had an original line of dope on his visit to convention, and as his trip lasted a month and ended at Montreal, you can draw your own conclusion as to why it lasted so long.

OBITUARY

Died—John De Mars, an old member of Newark Branch, highly esteemed by all and will be sadly missed.

Toronto Branch

The Toronto Branch held a real old-time meeting on Monday, July 23, President Barrows in the chair, and a real good attendance tended to make the meeting a success. Routine business being promptly disposed of, it was decided to endavor to clean up on members in arrears. A personal canvass will be made and "hopeless" cases dropped from membership. I might here point out to some who are receiving the REVIEW, and who are not entitled to it through non-payment of dues, that you are being carried at the expense of your branch; that the "boys" of Toronto Branch are the ones who are paying your burden. Think it over. I am sure that in most cases, where members get behind it, it is just a case of overlooking the matter. Your secretary will guarantee your receipt by return mail, so send it on. Any form of cash accepted (that's service).

Secretary Coles read a paper on "Rochelle Salt as an Aid to Anode Corrossion in a Brass Solution," claiming great benefits from its use. The subject being one with which the members were not familiar, questions, which were numerous, were practically all of the nature of inquiries. We hope to see the paper published in the REVIEW, and a full criticism of the same, as the author would like to know if his claims can be borne out by the results of others.

President Barrows as delegate to the convention submitted a report, which was eagerly listened to, and its completeness spoken of. We feel we can verily say, "Providence is Wonderful."

A hearty vote of thanks being accorded to the speaker the meeting adjourned, with all present voting it an evening well spent.

Librarian O'Keefe has something "brewing" for the August meeting. We believe it is by Charles Kemish.

Boston Branch

Boston Branch met Friday, the 20th, at the American House, with President Nihan in the chair. After the regular order of business the application of B. F. Lee was approved by the board of managers, and he was elected to membership.

The committee reports were then in order. The delegates to the convention reported that it was the best that has been held in years. The branch thanked the delegates for the good work that they had done and for the way in which the members turned out.

The committee on research work made its report as follows: The research committee reports very good progress in the study of nickel itch, and the cases now being treated by Prof. Austin W. Cheever are responding to treatment far better than before treated.

Mr. Herrick has made this a special subject for the laboratory of the S. H. Chemical Company to study, and very good results are expected with such people working on it.

The chairman, Mr. Herrick, asks that all members who have any in formation on this subject to send it to the secretary of Boston Branch or to the S. H. Chemical Company, 6 Beacon street, Boston, Mass.

This subject was discussed at length and was interesting to all present.

Chicago Branch

The regular monthly meeting of Chicago Branch was held July 14, with a good attendance and owing to the convention report of the delegates the meeting proved very interesting, the report was very complete and this took up the biggest part of the evening.

Our librarian announced that, beginning next meeting, we are going to start discussing a "Plant Layout." First evening will be devoted to a talk on a proper floor for a modern and efficient plating department, and the following meetings to ventilation, tanks, tank lining, electrical wiring and solutions. The program as planned by our librarian is very good, and we expect to have a large attendance at each one of these meetings.

The following questions were in the Question Box:

Question No. 1—What is a good formula for a duplex copper solution?

Answer No. 1—Dissolve enough copper sulphate until the solution stands 15° Baume and add enough sulphuric acid to 17°Baume.

Question No. 2—What is the metal content of copper sulphate and copper carbonate?

Answer No. 2—Copper sulphate contains 25 per cent. of metalic copper and the copper carbonate 48 per cent. to 51 per cent., depending on the way it is manufactured. ?

CONNECTICUT VALLEY BRANCH

Hartford-Connecticut Valley Branch met on Monday, July 23, with President Vibberts in the chair and an attendance of ten members and three visitors. All of the members who had attended the convention gave enthusiastic reports of its success, and all mentioned the hospitality of the people of Providence.

It was voted that a circular letter be sent to manufacturers in this territory to acquaint them with the results of the Providence convention and urge the enrollment of their platers in the society.

Mr. Daybill gave a talk on silver plating stainless steel and showed a number of samples of his work. Nickel plated revolver parts were also shown by Mr. Vibberts, and Mr. MacFadyen had some very good zinc plated work to pass around.

Bridgeport Branch

After the routine business had been dispensed with, various members gave their experiences on their stay at Providence, of which all expressed a wonderful time. We had one application for membership, Joseph F. Gilmore, 696 Kossuth street, Bridgeport, Conn.

We are looking forward to September, as we intend to have an outing. Committees have been appointed to arrange for this outing.

Philadelphia Branch

As a mark of respect to the memory of Warren G. Harding, President of the United States, and in order to express its sense of this great loss, no meeting of Philadelphia Branch was held August 3. All business will be held over to the Septemper 7 meeting.

Montreal Branch

Regular meeting of Montreal Branch held Friday, the 20th inst., when our delegates reported back from the convention, and from their report many of the boys felt sorry they had not gone.

Our president, John H. Feeley, reported that he had done all in his power to get the convention. After hearing his remarks it was the feeling of the members that anything Montreal could do to make a success in Milwaukee next year should be done, stating that possibly Montreal may be able to get at least one good paper for them.

Our librarian, Mr. A. Giroux, has promised that he will read us something good at an early date.

APPLICATIONS

Hartford-Connecticut Valley Branch

Dennis B. Houlihan .....324 Grove St., Chicopee Falls, Mass.

Philadelphia Branch

William M. Carrick, Active .....633 N. 12th St., Philadelphia, Pa.
Ernest Eiscle, Active .....2045 Wilmot St., Philadelphia, Pa.
Anthony Mancuso, Active .....627 Park Ave., Pensauken, N. J.
B. A. Fulmer, Active .....619 Chestnut St., Lancaster, Pa.

Chicago Branch

Emil F. Sward, Active .....2421 Karlov Ave., Chicago, Ill.

Newark Branch

Frederick S. Bruen, Active .....90 W. 19th St., Matawan, N. J.

Bridgeport Branch

Joseph F. Gilmore.....696 Kossuth St., Bridgeport, Conn.

New York Branch

Mr. George Shea, Active.....1396 Greene Ave., Brooklyn, N. Y.
Mr. Max Golden, Active.....616 Howard Ave., Brooklyn, N. Y.

RESIGNATIONS

Philadelphia Branch

D. A. Metz .....7205 Buist Ave., Philadelphia, Pa.
F. T. Gabrylewitz .....810 Callowhill St., Philadelphia, Pa.

ELECTED TO MEMBERSHIP

Philadelphia Branch

D. F. Cranor, Active .....Conshohocken, Pa.

Grand Rapids Branch

J. Duetcher, Active .....7577 N. Trout Ave., Grand Rapids, Mich.

Newark Branch

Horace G. Gravelle, Active .....185 Kingsland Road, Nutley, N. J.
Max Metch, Active.....3804 Hudson Bvld., West Hoboken, N. J.

Boston Branch

Bartholomew F. Lee, Active .....56 Freemont St., Mattapan, Mass.

Dayton Branch

Fred Zeniter, Active.....418 N. Williams St., Dayton, O.

SUSPENSIONS

Mr. George Lanz.....Dayton Branch

BOSTON

Regular meetings are held third Friday of each month, at 8 p. m., at the American House, Boston. Secretary, A. W. Garrett, 821 Dorchester Ave., Dorchester, Mass.

BRIDGEPORT

Meets first and third Friday of each month in its laboratory, 260 John St., Bridgeport, Conn. Secretary, David Fleming, 97 Roosevelt St., Bridgeport, Conn.

CHICAGO

Meets second Saturday of each month, at 8 p. m., at the Hardware Club of Chicago, Room 1125. Secretary, R. J. Hazucha, 5128 Warwick Ave., Chicago, Ill.

CINCINNATI

Meets on the first and third Friday in each month, Y. M. C. A. Building. Secretary, W. J. Husing, 729 McMakin Ave., Cincinnati, Ohio.

CLEVELAND

Meets last Saturday of each month at Hotel Winton. Secretary, H. S. Kneeland, 3924 Clybourne Ave., Cleveland, Ohio.

HARTFORD

Meets on the fourth Monday of each month at 747 Main St., Hartford, Conn. Secretary, Robert Mandeville, Midian Ave., Windsor, Conn.

DAYTON

Meets first Saturday of each month at the Y. M. C. A., Dayton, Ohio. Secretary, Wm. Hohman, 123 N. Webster St., Dayton, Ohio.

DETROIT

Meets first Friday of each month at the Old Colony Club, 2nd floor, Hotel Tuller. Secretary, E. W. Woodmensee, 1427 Lee Place. Detroit, Mich.

GRAND RAPIDS

Meets on the second Wednesday of each month at the Vocational High School, 129 Bostwick Ave., N.E. Secretary, Chas. S. Whalley, 931 Pine Ave., N.W., Grand Rapids, Mich.

INDIANAPOLIS

Meets the second Saturday of each month at Hotel Denison. Secretary, Louis Mertz, 1725 Union St., Indianapolis, Ind.

MILWAUKEE

Meets second and fourth Thursdays of each month at Lipps Hall, 321 3d St. Secretary, R. Steuernagel, 1508 Concordia Ave., Milwaukee, Wis.

MONTREAL

Meets every Friday at 84 Craig St. West. Secretary, John H. Feelay, 411 Aylmer St., Quebec, Canada.

NEWARK

Meets first and third Fridays of each month at No. 17 Central Ave., Newark, N. J. at 8 p. m. Secretary, George Reuter, 30 Maple Ave., Irvington, N. J.

NEW YORK

Meets second and fourth Fridays of each month at the Broadway Central Hotel Parlors, New York City. Secretary, John E. Sterling, 468 Grand Ave., Long Island City, N. Y.

PHILADELPHIA

Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts. Secretary, P. Uhl, 2432 North 29th St., Philadelphia, Pa.

PITTSBURGH

Meets first Saturday of each month at 8 p. m., at United States Bureau of Mines Bldg., Forbes St. Secretary, S. E. Hedden, 227 Fifth St., Aspinwall, Pa.

PROVIDENCE-ATTLEBORO

Meets first and third Thursday of each month at 26 Custom House St., Room 16. Secretary, Robert Crook, 185 County St., Attleboro, Mass.

READING

Meets on the second Tuesday of each month. Secretary, William M. Fisher, 654 Gordon St., Reading Pa.

ROCHESTER

Meets every second and fourth Saturday of each month at the Hotel Seneca. Albert H. Doering, Secretary, 49 Cutler St., Rochester, N. Y.

SYRACUSE

Secretary, M. J. Crean, 109 Court St., Syracuse, N. Y.

ST. LOUIS

Meets first Tuesday of each month at Barr Branch Library, corner Jefferson and Lafayette Sts. Secretary, H. H. Williams, 4156 Botanical Ave., St. Louis, Mo.

TOLEDA

Meets first Thursday of each month at Toledo University Science Building, Electro-Platers' Room, corner Cherry and Page Sts. Secretary, W. W. Weiker, 411 3d St., Toledo, Ohio.

TORONTO

Meets fourth Monday of each month at Canadian Foresters' Hall, 22 College St., Room No. 2. Secretary, E. Coles, 66 August Ave., Toronto, Ontario, Canada.

WATERBURY

Meets every second and fourth Friday of each month. Secretary, Wm. Delage, 47 Prospect St., Waterbury, Conn.